Journal of Theoretical and Applied Information Technology
31st August 2016. Vol.90. No.2

ISSN: 1992-8645 www.jatit.org E-ISSN: 1817-3195

THE RELIABILITY OF HALAL PRODUCT TRANSPORTATION USING GPS TRACKING SYSTEM

[1]MAIZATUL AKMA MOHAMAD, [2]SHATTRI MANSOR, [3]NOORDIN AHMAD, [4]WAN AZIZUN WAN ADNAN, [5]ISLAM MUHAMMAD WALI

[1]Geospatial Information Research Center, Faculty of Engineering, Universiti Putra Malaysia

[2]Prof. Geospatial Information Research Center, Faculty of Engineering, Universiti Putra Malaysia

[3]Assoc. Prof., National Space Agency, Malaysia Space Center

[4]Assoc. Prof., Department of Computer and Communication System Engineering, Faculty of Engineering, Universiti Putra Malaysia

[5]Geospatial Information Research Center, Faculty of Engineering, Universiti Putra Malaysia

E-mail: [1]akma.mohamad@gmail.com, [2]shattri@upm.edu.my, [3]noordin@angkasa.gov.my, [4]wawa@upm.edu.my, [5]islamwali@gmail.com

ABSTRACT

The rapid growth of Halal product market creates high demand for the logistic system to ensure the reliability of product during the transportation process. However, due to contamination, pilferage and chance of breakage in the supply chain, the reliability of the current status of halal product has been questioned that leads to the initiative of developing a new tracking system to monitor the movement of the product. Aiming at monitoring and reducing the possibility of cross contamination that might occur during the transportation process, the Halaltracer tracking system was developed using the combinations of Global Positioning System (GPS) and geofence algorithm. The Halaltracer tracking system is significantly contributing in terms of automatic detection on the spatial activity taken during the halal product's shipment process. Apart from providing spatial information about the delivery session and the route taken, the system also can detect the possibility of cross contamination by monitoring in real time the stopping of vehicles using a ray casting algorithm applied to the geofence technique used in the system. A functional prototype device with a web based interface for reporting function was completely built and tested in different kind of situation. The testing showed that the proposed model was capable of presenting a report of tracking which compliant the requirement of managing Halal product. In conclusion, these Halaltracer system will improve the traceability of Halal product during transportation by focusing on the Halal part thus, adding the credibility of consumer confidence in consuming the Halal products.

Keywords: *Ray Casting Algorithm, Geofence, Halal Logistic, Global Positioning System, Traceability*

1. INTRODUCTION

Halal products are not guaranteed halal if the halal supply chain did not apply [1]. It is very crucial for the entrepreneurs to maintain the integrity of Halal product in the supply chain to prevent the customer from fraud on the quality of the product [2, 3]. The reliability of halal product has been questioned through the whole process starting from manufacturing, handling and delivering to end customer. The requirement to produce Halal foods arose as it was not only consumed by a Muslim, but non-Muslim too, since it guaranteed the cleanliness, healthiness and tastiness [4].

In ensuring the halal status of the product are protected, logistic plays very important role [5]. Logistic process was a big industry which covers on many aspects including transportation, warehousing, packaging and retailing. However, this study only focuses on the aspect on the spatial analysis on the transportation field. During the transportation process, the products must be segregated between Halal and non Halal in order to avoid cross-contamination to occur. There are few issues rising up the risk of cross-contamination to occur, such as sharing container, poor visibility of the container inventory, the transit place of the container, the history of immediate supplier and maintenance, and segregation allocation places [5].

Journal of Theoretical and Applied Information Technology
31st August 2016. Vol.90. No.2

ISSN: 1992-8645 www.jatit.org E-ISSN: 1817-3195

Moreover, this issue becomes more critical as to maintain the Halal performance responsibility also become a challenge. Due to other party didn't practice Halal supply chain; the chance of breakage becomes higher once the goods were transferred to another place. The manufacturer can only guarantee the halal status when the goods are in their custody [6].

Monitoring the transportation aspect in the Halal supply chain is very crucial. However, Malaysia is still in early stage of applying Halal supply chain for logistics [7]. Currently, Malaysia is moving towards of becoming a world Halal hub, therefore, the government now takes an initiative to ensure the integrity of halal product is preserved [8]. Based on this factor, Halal standard on management system requirements for transportation of goods and/or cargo chain service have to be implemented to all Halal operators. According to the standard, each organization shall establish and apply for a traceability system to identify the cargo or goods in the supply chain service. The organizations also need to ensure the system is enabled to identify the movement of the products in all stages specifically for the raw material supply into the last destination of the product [9]. This kind of urge has become the biggest motivation for creating the new traceability system which specifically focuses on managing Halal product.

Tracking system technology is one of the most appropriate ways to respond to Malaysia's government effort in creating the Halal traceability system. The tracking system has been broadly used to attain location information in several areas such as electronic commerce, military and logistic [10].

There are many types of sensors used in tracking the movement of product in logistic such as radio frequency identification (RFID) and global positioning system (GPS) [11]. Numerous studies have examined the potential of GPS for monitoring the movement of the consignment in supply chain, nevertheless, the conventional monitoring method using GPS was only monitored the movement of the product without considering the Halal aspect.

Currently, the concept of geofence was commonly practiced in GPS tracking system [13]. However, it was found that most of the applied geofence only focus on few situations, such as monitoring the detour in planning routes and provide alerts if the vehicle detours [14]. The systems proposed were using route adherence technique for geofence and gets the location data from off the shelf mobile technology through the Android API resources. Consist of three main component which is the device, mobile and server, the system called SWTRACK were developed to make sure the safeties of the fleet and cargo. The general user interface was also developing to show the alerts generate by the geofence and on the maps, the travel information can be view by different colour according to the situations [14].

In different study, the geofence is also used to provide alerts when a monitored vehicle or objects is entering or exiting the geofence area [15]. The end user can monitored the result by viewing it in both web and mobile application. This system monitors two aspects including setting speed and geographical limits. An alert will be sent via SMS if the vehicle exceeded the pre-defined limits. Using circular types of geofence area chosen by the

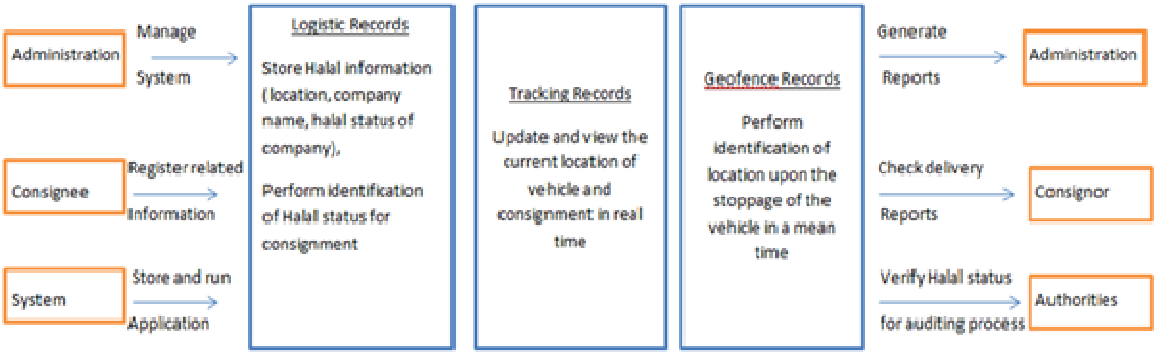


Figure 1: Proposed Logistic Transportation Tracking Framework

ISSN: 1992-8645 www.jatit.org E-ISSN: 1817-3195

administrator, this system works by looking if the vehicle entering and exiting geofence area, stops of vehicle and when the alarm going on [15].

Those techniques are unable to cater the needs of this study, which is to cover the possibility of cross contamination that might be occur during the transportation process if the vehicle carrying the Halal product stopped at unknown or non-halal area. Therefore, a rule should be applied in addition to the existing geofence technique for solving problems concerning.

This study presents Halaltracer, a system that allows the logistics service provider and authorities to monitor the activity that occurs during the delivery of Halal products. This system provides route information and with little improvement in existing geofence technique, the vehicle stopping area can be checked and alert will be issued if the vehicle stopped at unknown area. The system used GPS tracker as the core device offered the monitoring in real time mode and using the web based platform to present the result of tracking and alerts. Apart from giving the location information, this system also gives product information, so that the consignee and consignor both can trace where their product comes and go. This system is expected to solve the traceability problem proposed by the government and simply convert the manual method into an automatic method in ensuring the integrity of the halal product.

2. FRAMEWORK OVERVIEW

The Logistic Transportation Tracking Framework holds three main functions which are logistic records, tracking records and geofence records as shown in figure 1.

2.1 Logistic Records

The Logistic records function consists of records about the logistic activity happens during the movement process of the consignment. The consignee has to register their own information such as company name, address, halal's certificate number, vehicle registration number, driver name, GPS identification number and consignor information. Before loading process, the consignee will need to key in the consignment information to enable the traceability of the consignment when its move from their custody. In this stage, the identification of the Halal product is being done by assuming that the goods are halal since the consignee has halal status. This assumption is made as according to JAKIM requirement, only halal product is produced by the producer, manufacturer, food premise and slaughter house which receive the Halal certificate. The system database was built to store Halal information of the consignee and consignor.

2.2 Tracking Records

Every item delivered must have traceable identification to make sure there is no events of halal become non halal during the transportation process. The GPS tracking system will activated after the consignment successfully loading into the vehicle. The GPS will give the location information in every 5 minutes intervals. Consignee and consignor both will get the benefits as the system gives a real time view and reports of vehicle status and current locations. The GPS also gives other valuable information such as time and speed which will be used to generate stoppage geofence records.

2.3 Geofence Records

During the delivery process of Halal product from one place to another, there is a possibility of mixing and contaminations interference between halal and non-halal product. An application is built within the system to overcome this problem by helping to monitor this issue. Geofence is used to identify the location of the stopping vehicle by filtering according to speed and time range (more than 30 minutes). A computerized system is applied to give more specific record about the halal product whereabouts.

2.4 Process Flow

The proposed process flow for the Halal logistic transportation tracking framework is discussed according to figure 1.

1. Managing system: The entire system is managed by an administrator who will ensure the system continues to run smoothly without any problems. Only administrator has given the authority to access all parts of the system.
2. Register related information: Consignee will register related information required before the tracking process start. This information will later use to generate the tracking reports. Store and run the application: The system is programmed to store and run three parts of the function which is logistic record, tracking record, and geofence record.

Journal of Theoretical and Applied Information Technology
31st August 2016. Vol.90. No.2

ISSN: 1992-8645 www.jatit.org E-ISSN: 1817-3195

3. Generate reports: Based on the record obtain during the tracking process; the administrator will generate the report to be used by the needed party.
4. Check delivery reports: The results of the tracking can give benefit to the consignor as they will know the events happen during the transportation process.
5. Verify halal status for auditing process: During auditing process, authorities can easily check if there are any events occurring during the transportation process that leads to the possibility of halal product become non-halal product.

3. HALALTRACER MODEL

This research was intended to develop a real time traceability system for tracing the movement of the vehicle containing halal product. The development of HalalTracer system is intended to give both government and Halal logistic provider the monitoring of the route and stopping location of each vehicle carrying Halal product using GPS technologies in collaboration with the modified Geo fence application. This real time system was comprised into a module as shown in figure 2.

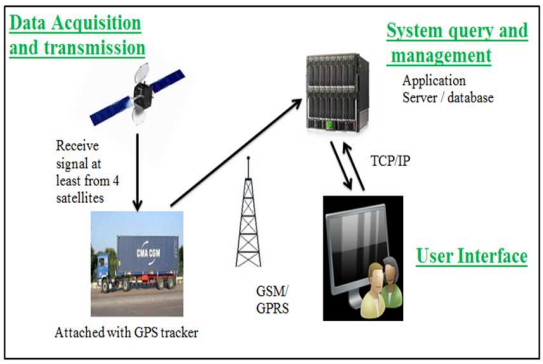


Figure 2: GPS Tracking System Module

3.1 System Requirement

The development of Halaltracer system starts with analyzing the requirement needed. The requirement was analyzed based on the proposed framework. The requirement covers on the selection of suitable device, hardware and software needed for the system. Based on figure 3, this study required GPS tracker as the main source for acquiring locational data for the monitoring process. GPS tracker is attached to the vehicle and it will get a signal from at least four satellites to acquire a location in terms of latitude, longitude, time, date and speed. The workspace will then read the specific rule that has been applied on the geofence based on the ray casting algorithm. Geofence is a spatial concept that widely known after the widespread use of GPS in the transportation industry. Live GPS location obtained from the GPS tracker will be connected with virtual fences created in the digital map. The system will perform spatial analysis to determine violation in terms of stoppage occurred. If the violation occurs, a notification message will be sent out via email to the administrator. When vehicle entering or exiting the fence, geofence will work by activating the trigger and provide alerts based on the rules that have been set up by the system. This research has used the rule to examine and filter the spatial and temporal element derived from the GPS data. When the vehicle starts moving, it will activate the GPS tracker and start collecting spatial and temporal data to be sent to the server by using GSM/GPRS as a communication medium. Then, the system will read the rules and spatial analysis is performed by examining whether the vehicle enter and stop at the fence or not in the specific time.

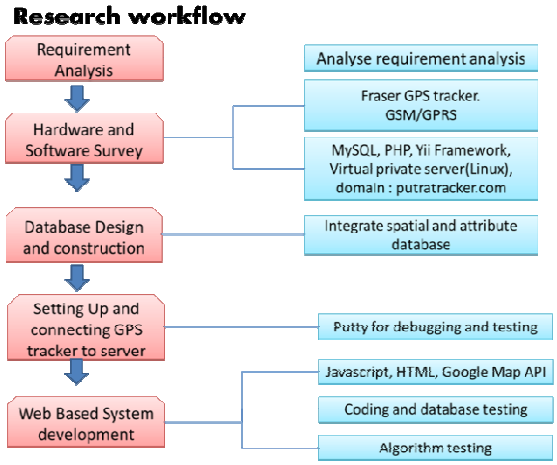


Figure 3: Overall Flowchart of the Diagram

The prototype has been built based on the proposed framework. GSM/GPRS technology has been applied as a communication method between the GPS tracker and the server. The GPS tracker is equipped with a GSM Cinterion MC55i module consist of Quad band GSM with 850/900/1800/1900 MHz frequency to control the instruction using AT command. Multi-slot class 10 GPRS was used in the tracker as it has the ability to transfer long-distance data widely and credibly [16].

ISSN: 1992-8645 www.jatit.org E-ISSN: 1817-3195

The system uses a virtual private server with support of LINUX as an operating system for retrieving data from the GPS tracker to the database. It was selected due to its ability of being more stable and reliable for the basic needs of web hosting. Furthermore, it can be customized according to the needs and offer cheaper costs compared with a dedicated server. Spatial database was used to store geographical data, which is capable of storing a large dataset capacity. Spatial database has a thousand features which can provide an efficient mechanism to store, query, analyzed update data in a system [17]. HalalTracer system has chosen MySQL as the database because its ability to support the vector data forms. Even though the ability is not comparable to the other spatial databases such as Post GIS and SpatiaLite, but it still provides a database function library. This function can be used with some MySQL storage mechanism, including InnoDB, MyISAM and ARCHIVE [18].

The system use web based platform and implement YII as a framework along with PHP as the language to run and manage the data received from the GPS tracker. An interface was created using HTML forms and the JavaScript Google Maps API to view the location report of the GPS tracker. The geofence location reports were differentiated using several markers to indicate Halal and unknown location. A few pages were developed to visualize the tracing and tracking of the vehicle and product. There's also pages for the user to register the GPS tracking device, company, vehicle and task to be done which includes the information of Halal product being transported.

3.2 System Implementation

Cross contamination is one of the main factors that cause the Halal product become non-Halal during the transportation process. To overcome this problem, Halaltracer System proposed the modified geofence application. Point in polygon concept was used to detect if the vehicle entering and stopping at Halal or unknown location. Instead of circular, polygons were selected to be used in this study as it is more preferred for a small area [19].

In this study, the polygon was drawn based on the Halal premise Floor Plan that obtained during the process of getting the Halal certificate. However, 100 meter buffer was applied, assuming the vehicle stopped approximately that area due to some problem such as limited loading and waiting space. The buffer was applied because there are some possibilities that the GPS cannot acquire a fix location due to any noise such as atmospheric conditions, electronic interference, physical obstruction (buildings and trees), and the sensitivity and sophistication of the GPS receiver itself. This noise can result in inaccurate fix position generate by the GPS receiver for about a factor of ten meters or more [20]. Therefore, extremely tight Geo-fence rule has to define to avoid false alert error [20]. There are many algorithms developed to check the point in polygon like Nordbeck and Rystedt algorithm, Winding Number algorithm, Quadrant method, Edge Cross test and Ray Casting method [21]. Rounding errors might cause the result of geofence incorrect when it is implemented on fine precision arithmetic computers. However, this problem can be neglected as in computer graphic application, speed is much more important than the accuracy. Thus, a ray casting algorithm was selected as it is the most powerful, fastest in execution and easy to implement.

Ray casting works with testing how many times the rays starting from the point is intersected with the polygon edge in order to check whether the point is in polygon or not [21]. If the number of the intersection is odd, it indicates that the point being tested is inside the boundary and otherwise it was outside the boundary.

Figure 4 shows the concept used in determining whether the point is inside the polygon or not. Point P (x, y) is the current point captured from the GPS tracker data. Since the entire point of this ray has the same Y coordinate, the ray will only shoot in the positive x direction starting from point P to describe a valid intersection. The calculation process is begun by counting the counter intersection as zero. Some situation needs to be checked during the carried out process. If $y1 < y$ and $y2 < y$ or $y1 \geq y$ and $y2 \geq y$, there's nothing to be done as both point is located on the same region. Otherwise, the intersection between point (Sx, Sy) with the line from point (x, y) has to be calculated. As a result, if $Sx \geq x$, the point is moving to the left of the intersection as the intersection value is increased. Lastly, all the edges of polygon have to be checked and point P is indicated as inside the polygon if the intersection is odd.

Journal of Theoretical and Applied Information Technology
31st August 2016. Vol.90. No.2

ISSN: 1992-8645 www.jatit.org E-ISSN: 1817-3195

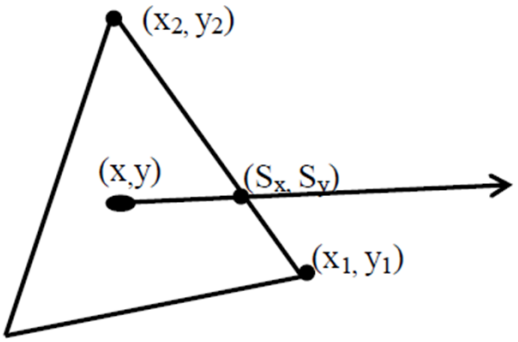


Figure 4: Geofence concept

4. RESULT AND DISCUSSION

The proposed system focusing on tracking and tracing halal product shipping process carried out by updating the location of the vehicle and provide the status when the vehicle stops at any place. This system runs on data obtained from the GPS tracker installed on the vehicle and the data obtained were processed to generate tracking and tracing reports. By keeping track the reports generated from this system halal status of the product can be identified in respect of events that occurred during the delivery process.

4.1 Location Update

The location update function obtained from the GPS tracker provides the vehicle's current location. Converted into latitude and longitude forms, the location histories were showed in map viewer to facilitate system users to view the location of the vehicle. Google Map was used to support the map viewer applications as it has advantages in providing the latest information compared with others map operators. Figure 5 shows an example of the path taken by the vehicles during the system testing process. A simple interface was developed to allow the user to register the GPS tracker and to view the tracker in map viewer mode. Other information such as time, speed, location name and vehicle details can be obtained in this side. Users can choose which tracker they want to view or choosing to view the entire tracker in one time.

4.2 Geofence stoppage status of the vehicle

Location data obtained from GPS tracker were processed to generate a report for stoppage geofence. The ray casting algorithm is proven to be used to check whether the vehicle enter and exit the geofence polygon. For this study, geofence was modified by combining the algorithm with the vehicle's stopping time and speed. Based on the testing made, it turns out that when the vehicle speed is 0 km/h for more than 30 minutes, the system will directly check whether the vehicle location is in the geofence area or at unknown place. If the location is within the geofence polygon which is halal area, then a green marker will be plotted on the map and listed as known location in the location stoppage report. Conversely, if the location is not on the geofence polygon, stoppage report location will be marked as yellow marker and alert will be sent via email to inform that the vehicle was not stopped at the designated places. By monitoring the vehicle status during the shipping process, indirectly, this system will avoid any possibility of mixing between halal and non-halal product that might occur if the vehicle stopped at an unknown location and load non –halal product at the halal vehicle.

4.3 System Verification

The developed system has been tested by creating some task to ensure the application of modified geofence has been functioning properly. Due to limited access and time constraint, this test was performed using a car which GPS tracker has been installed and connect properly to the server.

Prior to travel, information about the vehicle, driver, start location, Halal certificate number, lists of product and barcode are filled up into the system to covers the traceability aspect of the product. This information is crucial in order to ensure that only halal products are being transported and not being tampered with. After the information filling process carried out, the travel was initiated. The system will capture the time the GPS start and coordinates from the tracker and then stored it in the server. Aiming at verifying stoppage location, therefore, an unknown and halal point was selected to identify the effectiveness of the modified geofence created as can be seen in figure 5. The continuous line in the figure shows the route taken by the vehicle during the journey. Point 1 indicates the starting point and point 2 indicated the end point. The yellow marker indicates that during the journey, the vehicle had stopped at an unknown location. The server will send an alarm in email form to inform the unexpected event. This is important as there is possibility that the vehicle entering and stopped at non-halal location which will lead to the problem of cross contamination. Upon arrival at the destination, the product will once again be in check to make sure the same products were brought from the

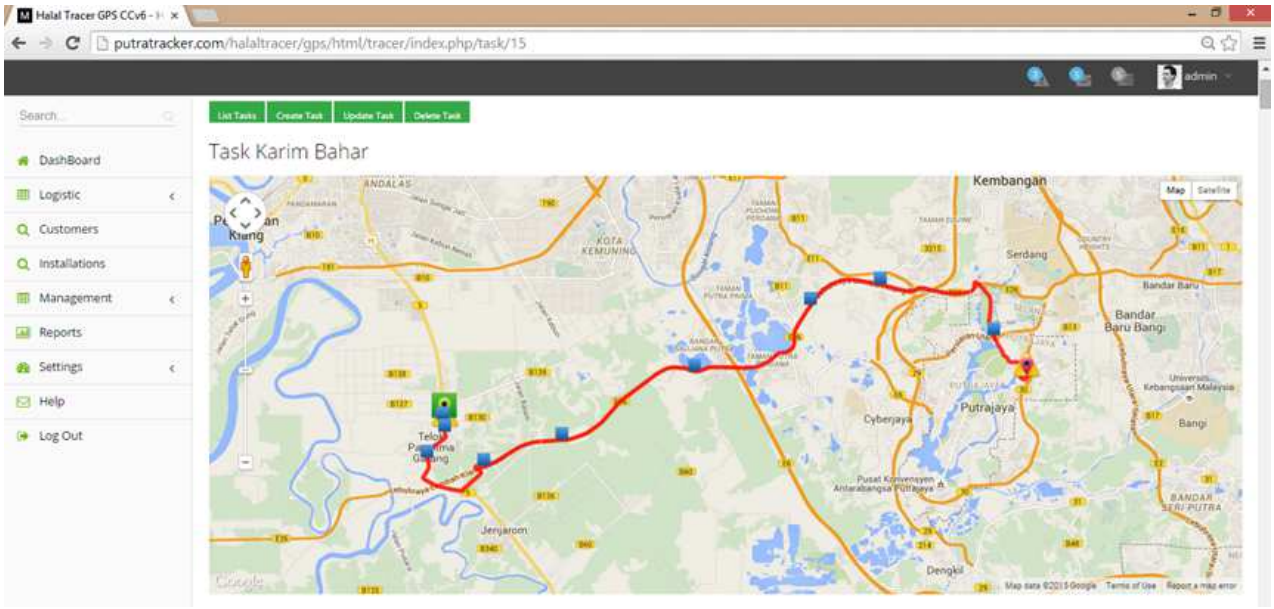
Journal of Theoretical and Applied Information Technology
31st August 2016. Vol.90. No.2

ISSN: 1992-8645 www.jatit.org E-ISSN: 1817-3195

beginning. Figure 6 shows the reports of task that will be used for traceability purposed.

Based on simulation done by the system, it was found that, by using the location as essential metric, a quantitative analysis of driver behaviour can be done. Previously, there are many research and works on location analytic; however with the enhancement of the new rule proposed in this Halaltracer system, a details analysis which combining the temporal and spatial analysis from the GPS tracker data was made. Based on this element, not only it can check whether the driver stop at designated area or not but it also can give new information on the places which might be operating Halal product but has no certificate on it. Thus, it will make it easier for authority or decision maker to make further actions by taking data from this Halaltracer system.

In addition, the administrator can perform an analysis of the time taken when the vehicle is stopped at the geofence area. If a violation occurs, an analysis of the cumulative time in/out can also be made along with analysis of the frequency of violations made by the vehicle. With its ability to provide information in real time, analysis of the time the vehicle might be reach its destination can be done thus it can facilitate the organizations for a better time management.



Stop Location					Location Status	
Latitude	Longitude	Duration Stop	Date & Time			
			From	To		
3.019752	101.383326	5 minutes	2014-12-27 08:36 AM	2014-12-27 08:41 AM	Known	
3.007697	101.438843	10 minutes	2014-12-27 09:16 AM	2014-12-27 09:26 AM	Known	

Figure 5: Web interface showing the path taken and geofence report

ISSN: 1992-8645 www.jatit.org E-ISSN: 1817-3195

ID	12
Consignment ID	100012
Driver Name	Karim Bahar
Driver ID	770901106790
Container ID	9012
Vehicle	Truck (ABC Sdn Bhd)
Company	Secret Recipe Inc
Date	2015-05-18 07:59:11
Time Start	2014-12-27 07:21:45
Location Start	Salman Sdn Bhd
Time End	2014-12-27 16:36:45
Location End	Jusco Bukit Tinggi
Consignee Name	Jusco
Consignee Address	Jusco Bukit Tinggi, Klang
Consignee Halal Cert No	b100000000012229

Figure 6: Report of task

5. CONCLUSION

Providing transparency and details information about transportation of Halal product is a crucial matter. This study aims to explore the way to convert the conventional method used in managing Halal transportation into a convenient and user friendly method which can be adapted into real time web based solution. This article presents Halaltracer, a system that allows products and vehicles that carry Halal goods to be track and trace during the shipment process. A prototype was developed based on the requirement and guideline of Halal transportation procedure given by the authority. The used of GPS tracker was applied in this system to get the latest location and routes travelled by the vehicle which is shown in the form of map and tabular report in the web browser. Instead of other available algorithm, ray casting algorithm has been chosen to be used in the geofence technique. The modified geo fence which integrate with spatial, temporal and speed rule was successfully implemented in the system that provides an email alert when the vehicle suspiciously stops in unknown place in a certain time. In addition, the system also successfully provides tracing information for the product where it can help identifying the origin and the next destination.

The system testing showed that the system can run smoothly and gives alert at the end of tracking if there is a stoppage at an unknown location. However, the false alarm might occur as the system check every unknown stoppage without any specification. The location might be non-halal premise, restaurant, petrol station or other possible place. In order to avoid this problem, in the future, other sensor such as weighing scale and door sensor is suggested to integrate with this system. The process of inserting the consignment information was done manually. It might leads to inaccurate information due to human mistake. Therefore, in the future, the use of barcode sensor, QR code or RFID can be integrated in the system. Another improvement also can be made by implementing this system in mobile version for tablet either in Android or IOS version to make it more users friendly and flexible.

This system gives benefits to both government authorities and Halal logistic service provider. Since the system is converting the manual procedure into a web based system, it will be much more effective and verification can be done automatically. Furthermore, it supports the authorities a proof of events happen during the transportation process. For the Halal logistic service provider itself, this system will helps them to track and trace their product in order to make sure the Halal quality of their product is maintained.

REFRENCES:

[1] A.H. Ngah, Y. Zainuddin, and R. Thurasamy, "Adoption of Halal Supply Chain among Malaysian Halal Manufacturers : An Exploratory Study" *Procedia - Social and Behavioral Sciences*, Vol. 129, 2014,pp. 388–395.

[2] M. Tieman, "The Application of Halal in Supply Chain Management: In-Depth Interviews" *Journal of Islamic Marketing*, Vol.2, 2011,pp.186-195.

[3] S.S.M. Bahrudin, M.I. Illyas, and M.I. Desa, " Tracking and Tracing Technology for Halal Product Integrity over the Supply Chain" *International Conference on Electrical Engineering and Informatics*, Bandung (Indonesia),July 17-19,2011,pp.1-7.

[4] M.S.A. Talib, and M.R.M. Johan, "Issues in Halal Packaging: A Conceptual Paper" *International Business and Management,* Vol.5, No. 2, 2012, pp.94-98.

[5] M.I.I. Tan, R.N. Razali, and M.I. Desa, "Factors Influencing ICT Adoption in Halal

ISSN: 1992-8645 www.jatit.org E-ISSN: 1817-3195

Transportations: A Case Study of Malaysia Halal Logistics Service Providers" *International Journal of Computer Science Issues*, Vol.9, Issue 1, No. 2, 2012, pp. 62-71.

[6] H.S. Jaafar, I.R. Endut, N. Faisol and E.N. Omar, "Innovation in Logistic Services – Halal Logistics" *Proceedings of the 16th International Symposium on Logistics (ISL)*, Berlin (Germany), July 10-13, 2011, pp.844-851.

[7] M.S.A. Talib, L. Rubin, and V.K. Zhengyi, "Qualitative Research on Critical Issues in Halal Logistics" *Journal of Emerging Economies and Islamic Research*, Vol.1, No. 2, 2013, pp.1-20.

[8] N.M.N. Muhammad, F.M. Isa, and B.C. Kifli, "Positioning Malaysia as Halal-Hub: Integration Role of Supply Chain Strategy and Halal Assurance System" *Asian Social Science*, Vol. 5, No. 7, 2009, pp. 44-52.

[9] Standard, D. o. (2010). *MS 2400-1:2010 (P) Halalan-Toyyiban Assurance Pipeline - Part 1: Management System Requirements for Transportation of Goods and/or Cargo Chain Services.* Malaysia Standard.

[10] J.S. Kim, H.J. Lee, and R.D. Oh, "Smart Integrated Multiple Tracking System Development for IOT based Target-oriented Logistics Loation and Resource Service", *International Journal of Smart Home*, Vol.9, No.5, 2015, pp.195-204.

[11] X. Zhu, S.K. Mukhopadhyay, H. Kurata, "A Review of RFID Technology and its Managerial Application in Different Industries", *Journal of Engineering and Technology Management*, Vol.29, No. 1, 2012, pp. 152-167.

[12]N. Chadil, A. Russameesawang, P. Keeratiwintakorn, "Real-Time Tracking Management System Using GPS, GPRS, and Google Earth", *5th International Conference on Electrical Engineering/Electronics, Computer, Telecommunications and Information Technology*, 2008, pp. 393-396.

[13] F. Reclus, K. Drouard, "Geofencing for Fleet & Freight Management", *Intelligent Transport Systems Telecommunications, (ITST), 2009 9th International Conference on*, October 20-22, 2009, pp. 353-356.

[14] R.R. Oliveira, F.C. Noguez, C.C. Costa, J.L. Barbosa, M.P. Prado, " SWTRACK: An Intelligent Model for Cargo Tracking Based on Off-The-Shelf Mobile Devices", *Expert Systems with Applications*, Vol 40, Issues 6, 2013, pp. 2023-2031.

[15] I.M. Almomani, N.Y. Alkhalil, E.M. Ahmad, R.M. Jodeh, "*Ubiquitous GPS Vehicle Tracking and Management System*", 2011 IEEE Jordan Conference on Applied Electrical Engineering and Computing Technologies (AEECT), December 6-8, 2011,pp. 1-6.

[16] M.Unde, and B.Borkar, "Remote Vehicle Tracking & Driver Health Monitoring System Using GSM Modem & Google Maps", *International Journal of Computer Science and Information Technologies*, Vol 5, No. 3, 2014, pp. 2828-2832.

[17] N.S. Swain, K. Latu, S.D. Christensen, N.L, Jones, E.J. Nelson, D.P. Ames, and G.P. Williams, " A Review of Open Source Software Solution for Developing Water Resources Web Applications", *Environmental Modelling & Software*, Vol. 67, 2015, pp. 108-117.

[18] S. Steinoger and A.J.S Hunter, " Free and Open Source GIS Software for Building a Spatial Data Infrastructure*", Geospatial Free and Open Source Software in the 21st Century, Proceeding of the first Open Source Geospatial Research Symposium, OGRS, 2009*, part 5, 2012, pp. 247-261.

[19] Y.K. Yuce, K.H. Gulkesen, and E.N. Barcin, " Balancing Autonomy and Security over Geotracking Patients with Alzhemer's using a Personalized Geotracking System with Social Support Network". *The 2nd International Workshopon Pervasice and Ambient Applications, Systems and Technologies for Healthcare (PASTH 2012), Procedia Computer Science*, Vol. 10, 2012, pp. 1064-1072.

[20] G. Williams, P. King, and K. Doughty, " Practical Issues in the Selection and Use of GPS Tracking and Location Technologies to Support Vulnerable People at Risk of Becoming Lost or Threatened", *Journal of Assistive Technologies*, Vol.5, Issue 3, 2011, pp. 146-151.

[21] T. Mantoro, M. Akhtaruzzamand, M. Mahmud, and M.A. Ayu, "Design and Development of an Interactive Monitoring System for Pilgrims in Congregation of Hajj Ritual", *Journal of Convergence Information Technology (JCIT)*, Vol.10, Issue 1, 2015, pp. 28-58.